AUTOMATED AND HIGH SPEED MACHINE DESIGN FOR TELECOMMUNICATION PRODUCTS

49 : __ __ __

Jeremy Li, Yajuan Shi
Department of ME, School of Engineering, University of Bridgeport

ABSTRACT

This research focuses on an automated and high speed machine design, which is assembling the bronze wire inside the plastic block, according to the manufacturing and production specification. In this design project, automated system performs special kind of operation in assembly line and it divided in five different stations. The function at first station is wire loading, feeding and straightening the wire. The function in second station is uploading the plastic block into the assembly line and holding the block precisely for inserting the bronze wire. The third station include of wire inserting into the plastic block and cut wire at desire length. The fourth station takes care of bending wire and final station take care of inspection of final assembly product by using appropriate sensors techniques. This project is mainly focus on utilization of automated machinery with simple tooling and fixture with low cost, which properly inspected at each station and easier to maintain in working at "high speed" repeatedly. It also explains major design problems and understands of engineering technology and limitations.

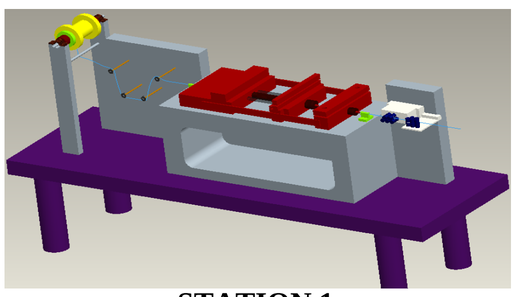
INTRODUCTION

Design of an automated machinery system requires to consider many different design principles that are different from regular conventional machines designing procedure. Automated machining brings different problems in design area ; such as high acceleration and high declaration, unpredictable forces and moments while machine is working , more repeatable than normal machines in high volume production, requiring more accuracy at right positioning and design materials and special environmental units. This project is to design an automated assembly machine to assembly the Ø 0.5mm bronze wire into the Ø 0.5mm plastic block hole at high volume production rate, Since it is automated machine design system care should be taken that all the design layout and calibration are accurate otherwise it would cause a lot of damaged to the product. The whole assembly process is fully automated at high speed with cost-effective, simple tooling and fixture, and easy to be maintained.

The first station : Loading, feeding and straightening of wire

Component for this station:

NO	NAME
1	Wire Reel
2	Roller Pulley (4)
3	Rapid Air Feeder
4	Wire Straightened



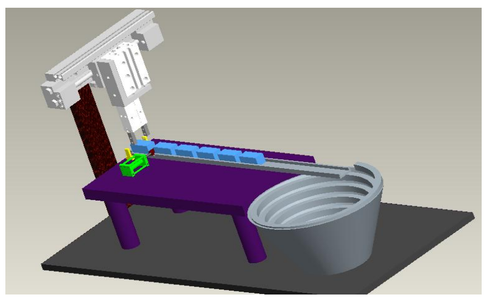
STATION 1

The material reel is mounted on the shaft and it locking by the bush and screw arrangement and then the whole shaft assembly is mounted on the table stand. The wire passes through the reel and then it mounted on four pulleys so that the wire gets easy motion at feeding. Before entering to the Feeder the wire passes through the wire guider which restricts the wire to go out of path. The wire in the feeder machine is feeding through Precision rapid air feed (AX-2).The installations of stainless steel telescoping tubes enable the Air Feed to deliver wire smoothly and accurately to the machine. Whip and buckling problems disappear when using the Wire Feed for round or nearly round materials over both long and short progressions. After precisely feeding wire through the feeder it again passed to the other wire guider and get wire straightened. It straightens the wire which is coming out of the wire feeder through wire guider and then wire goes to the plastic block in next station.

The Second station : Block loading

Co

NO	NAME
1	Vibrating Bowl
2	Metal Conveyor
3	Linear Pneumatic Actuator and Gripper
4	Pneumatic Stopper



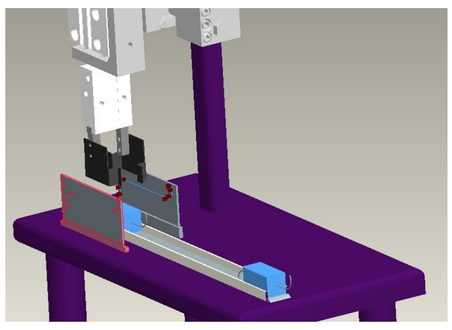
STATION 2

This function mainly introduces to getting plastic block at proper orientation to the production line. To this operation we use a one conical shape vibrating bowl to supply the plastic block at correct orientation to the metal rail conveyor. The metal conveyor is used for transporting plastic block from the vibrating bowl and place at where block is used to be taken a gripper. The process; at where blocks is continuous feeding to the metal conveyor rail a proper stopper mechanism is designed to stop blocks and passed at one by one at end of the rail and stop by the end stopper. Where grippers pick the block and placed at proper orientation at third station.

The Fifth station : Product inspection

C

NO	NAME
1	Metal Conveyor
2	Pneumatic stopper
3	Photoelectric sensors (8)
4	Linear Actuator and Gripper
5	Pneumatic Slider



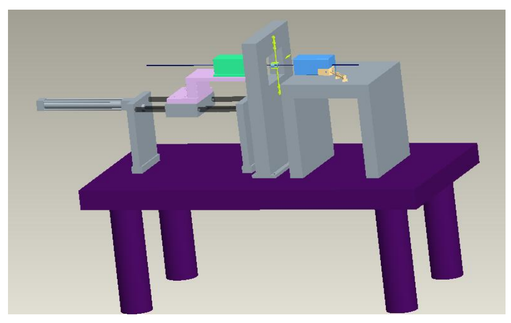
STATION 5

During this operation, two main things have to be inspected: the assembly product dimensions and bending angles of wire. Inspection should be done through the photo electric (through beam type) sensing technique. The sensors are mount to10 mm above at one side of the rail with help of the support block and to cover the whole wire profile at 0°, 45°, 90° and 120° at both ends of the wire product assembly. Product assembly is moving towards inspection station on to the conveyor rail and then the linear pneumatic stopper stops the product. After that gripper arm is used to pick up the assembly up to the sensors position (10 mm up) vertically to the conveyor rail and hold until the sensor inspect the product assembly. The gripper arm is designed in such way that it can take care of wire position at sensing time of the product assembly. Later the inspected product assembly is transfer horizontally with the help of the slider assembly and move to the product acceptance or rejection area.

The Third station : Wire inserting and cutting

Component for this station:

NO	NAME
1	SG Pneumatic Slider
2	Metal Cutter
3	Linear Pneumatic Actuators (4)
4	Square Hole Guide block



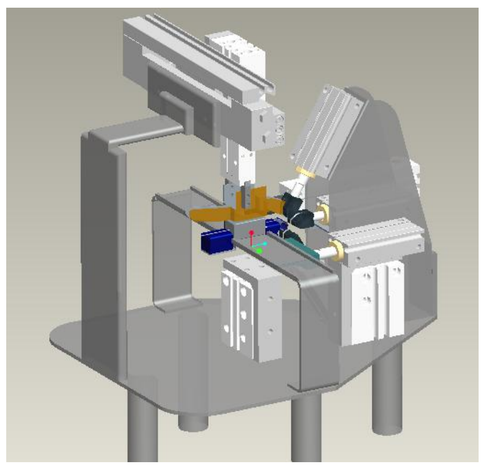
STATION 3

This station mainly focus on wire inserting and cutting. The whole fixture design assembly station is mounted into the base table and divided into the three parts like slider assembly, cutter assembly and plastic block mounted to the support table. The plastic block is properly grabed at its two opposite corner with the help of the fix L plate and movable L plate. The SG slider is mounted on the base plate with the Z shape-carrier and Guide block (green).Purpose of the square hole guide block is guiding wire precisely and inserting into the plastic block. The cutter assembly mounted with the top v- groove and bottom round shape holders to the linear pneumatic actuators and perpendicular mounted with the cutter to the linear pneumatic actuator. First an assembly line is set to insert wire into the guide block through the plastic block and cut wire at desire length for the first product. During wire inserting section wire is continuous feeding through the feeder, at same time SG pneumatic slider is slide and wire accurately inserting into the plastic block with help of the guide block and then slider stop to slide for 1 second at the time wire getting its desire length into the plastic block. And after that feeder also stop for couple of second and slider came back to its initial position. At same time top and bottom wire holders release into the linear pneumatic actuators and grab wire precisely. Then perpendicular mounted cutter releases the linear pneumatic actuator and cut wire accurately at fraction of second.

The Forth station : Wire bending and forming

Component for this station:

NO	NAME
1	SHP Linear Pneumatic Sliders (3)
2	Linear motion cylinders and pusher (3)
3	SFM pneumatic slider
4	Linear Actuator and Gripper



STATION 4

The goal on this step is to design the wire bending station. This operation is follows after insertion when the block is transferred to bending station. Both end of the wire requires bending over 120°at 5mm radius. First wire is bending at bottom side of 120°; To comply with 120°as requested, the overall bending degree can be divided into a two 60°. Two shaped components driven by a miniature bottom and centre cylinders are actuated and aim to punch the wire from different angle to bend the wire in the sequence. Both shaped component is responsible for 60° bending angular respectively. To guarantee that edges of shaped component will not cut the wire, the wire bending actuates cylinders is back to the home position. Afterward at same time support assembly cylinder and semi-circle shape guider actuate vertical direction with wire assembly, and then semi-circle shape guider easily relies from the wire assembly. Next assemble gripper picks up the wire assembly and rotate at 360°to the wire assembly and place for the other end of the wire to bending at top side of 120°.During this operation centre and top mounted cylinders are actuated and bending the wire precisely at 120°. After that whole assembly is properly gripped through the external grippers at vertically and transfer to the next station.

Conclusion

This research provides an insight of criteria and concept of automated and high speed machinery design and manufacturing. Approaching and solving a problem by adopting engineering and design leverage is a challenging and rewarding experience. The prototype shows its functionality, feasibility, reliability and cost-effective in manufacturing processes..